



## Phylum Gastrotricha\*

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\* In: Zhang, Z.-Q. (Ed.) Animal Biodiversity: An Outline of Higher-level Classification and Survey of Taxonomic Richness (Addenda 2013). *Zootaxa*, 3703, 1–82.

### Abstract

An updated classification of the two orders of the phylum is provided up to family level, and numbers of genera and species described so far are specified. The phylum is composed of two orders: Macrotrichida, with 9 families, 33 genera (+1 genus *incertae sedis*) and 338 species (+1 species *incertae sedis*), and Chaetonotida, with 8 families, 30 genera and 454 species. Current taxonomy is relatively stable for the order Macrotrichida, except for the presence of a monotypic genus which cannot yet be assigned with certainty to any of the existing families. On the contrary, the taxonomy of the order Chaetonotida has been repeatedly revised in the last decades and is still unstable. An integrate taxonomical approach on morphological and molecular bases appears necessary in order to revise the current classification according to phylogenetic relationships.

**Key words:** Gastrotricha, classification, diversity

### Introduction

The present list concerns the current classification of the orders, suborders and families of marine and freshwater Gastrotricha.

The taxonomy of the phylum is still mainly founded on morphological traits of both the external structure and the internal anatomy, like the shape and size of body regions and cuticular ornamentations, the organization of the reproductive system and the ultrastructure of spermatozoa. However, in particular the external features appear often variable at species level, and in some cases also at genus level, so making a certain taxonomic identification quite problematic.

After the first, basic monographies of the whole phylum by Zelinka (1889) and Remane (1936), the following increasing research on both gastrotrich orders has led to a number of taxonomical studies and revisions. The most recent and comprehensive contributes to the taxonomy of the phylum have been realized by Hummon (2009) and Hummon & Todaro (2010) on marine species, and by Schwank (1990), Kisielowski (1991, 1997, 1998), Balsamo *et al.* (2009) on freshwater species. Active studies have been performed on the fine morphology and molecular features of numerous species with the aim to define the intra-phylum phylogeny.

The extant species of Gastrotricha described so far amount to 793 (17 families, 63 genera + 1 *incertae sedis*): of these 338 species (+ 1 *incertae sedis*) belong to the order Macrotrichida (9 families, 33 genera + 1 *incertae sedis*), and 454 to the order Chaetonotida (8 families, 30 genera); 465 species are marine, 4 have been reported only from brackish waters and 324 are freshwater.

The order Macrodasysida includes all but two marine species. One freshwater species belongs to the family Redudasyidae that, however, also comprises a marine species. Another freshwater species has been assigned to the order as *incertae sedis* (*Marinellina flagellata*). The order Chaetonotida encompasses 128 marine, 4 brackish-water and 322 freshwater species. Three families (6 genera) are exclusively marine (Neodasyidae, Muselliferidae, Xenotrichulidae), 4 (12 genera) are exclusively freshwater, and the largest family, Chaetonotidae, numbers marine and freshwater species (2 genera exclusively marine, 5 freshwater and 5 including marine, brackish-water and freshwater).

Lists of world Gastrotricha species are available. For marine species see Hummon (2009), Hummon & Todaro (2010) and WoRMS (World Register of Marine Species, <http://www.marinespecies.org>, accessed 21 August 2013).

For freshwater species see Balsamo *et al.* (2009), Fauna Europaea (<http://www.faunaeur.org>, accessed 21 August 2013), Freshwater Animal Diversity Assessment (FADA, <http://fada.biodiversity.be>) accessed 21 August 2013), BioFresh Platform (<http://www2.freshwaterbiodiversity.eu>, accessed 21 August 2013).

The geographic distribution of marine Gastrotricha is generally well-known from a number of world areas, whereas that of freshwater species has not yet been studied enough. Some marine species show an unexpectedly cosmopolitan distribution ('the meiofauna paradox', Giere 2009), which may be related to a misidentification and lumping of cryptic species with narrow distributions as well as to the long-distance dispersal ability of a number of species (Artois *et al.* 2011; Kieneke *et al.* 2012). The distribution of freshwater species, on the other hand, appears quite heterogeneous, probably reflecting the researchers nationality, and mainly concerns Europe, North- and South America (Balsamo *et al.* 2008).

A recent estimate of marine species, based on the WoRMS database, has suggested that about 1800–2800 species have still to be discovered on morphological and/or molecular base for a total estimated species number ranging from 2244 to 3244 (Appeltans *et al.* 2012).

Due to slightly differences between current taxonomical schemes, we specify that the present list is mainly based on the classifications followed by Hummon & Todaro (2010) as concerns Macrodasysida and by Balsamo *et al.* (2009) for Chaetonotida.

## Classification

Phylum **GASTROTRICHA** Metschnikoff, 1865 (2 orders)<sup>1</sup>

Order **Macrodasysida** Remane, 1925 [Rao & Clausen, 1970] (9 families)<sup>2,3</sup>

Family **Cephalodasyidae** Hummon & Todaro, 2010 (7 genera, 33 species)<sup>4</sup>

Family **Dactylopodolidae** Strand, 1929 (3 genera, 14 species)

Family **Lepidodasyidae** Remane, 1927 (1 genus, 9 species)

Family **Macrodasysidae** Remane, 1926 (2 genera, 51 species)

Family **Planodasyidae** Rao & Clausen, 1970 (2 genera, 9 species)

Family **Redudasyidae** Todaro, Dal Zotto, Jondelius, Hochberg, Hummon, K  nneby & Rocha, 2012 (2 genera, 2 species)<sup>5</sup>

Family **Thaumastodermatidae** Remane, 1927 (2 subfamilies, 8 genera, 159 species)

Family **Turbanellidae** Remane, 1926 (6 genera, 57 species)

Family **Xenodasyidae** Todaro, Guidi, Leasi & Tongiorgi, 2006 (2 genera, 4 species)

*incertae sedis* (1 genus: *Marinellina*, 1 species)<sup>6</sup>

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1. The classification and diversity estimates follow mainly Balsamo *et al.* (2009), taking in account also Hummon & Todaro (2010) for marine species and updated literature.
  2. The phylum has been traditionally divided into two orders since the establishment of the class Gastrotricha within the phylum Aschelminthes (Hyman 1951). The order Macrodasysioidea was introduced by Remane (1925): since the designation connotes a superfamily taxon (Art. 29A ICZN), it was emended into Macrodasysida by Rao & Clausen (1970).
  3. Macrodasysida species are all marine interstitial, except for two, freshwater interstitial (*Redudasyys fornerise* Kisi  lewski, 1987 and *Marinellina flagellata* Ruttner-Kolisko, 1955).
  4. The genus *Psammodasyys* d'Hondt, 1974 is considered as a synonym of the genus *Cephalodasyys* by Hummon (2008).
  5. This family gathers two monospecific genera: *Redudasyys*, freshwater, and *Anandrodasyys*, marine.

Order **Chaetonotida** Remane, 1925 [Rao & Clausen, 1970] (2 suborders)<sup>7, 8, 9, 10</sup>

Suborder **Multitubulatina** d'Hondt, 1971 (1 family)

Family **Neodasyidae** Remane, 1929 (1 genus, 3 species)

Suborder **Paucitubulatina** d'Hondt, 1971 (7 families)

Family **Chaetonotidae** Gosse, 1864 (2 subfamilies, 12 genera, 363 species)

Family **Dasydytidae** Daday (1905) (7 genera, 41 species)

Family **Dichaeturidae** Remane, 1927 (1 genus, 3 species)

Family **Muselliferidae** Leasi & Todaro, 2008 (2 genera, 5 species)

Family **Neogosseidae** Remane, 1929 (2 genera, 9 species)

Family **Proichthyidiidae** Remane, 1927 (2 genera, 2 species)

Family **Xenotrichulidae** Remane, 1927 (2 subfamilies, 3 genera, 28 species)

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6. This genus includes only *Marinellina flagellata* Ruttner-Kolisko, 1955, a species *incertae sedis* only reported from Austrian interstitial fresh waters.
  7. The order Chaetonotoidea was introduced by Remane (1925): since the designation connotes a superfamily taxon (Art. 29A ICZN), it was emended into Chaetonotida by Rao & Clausen (1970).
  8. Chaetonotida include 128 marine interstitial species; 4 strictly brackish-water species, and 322 freshwater, epibenthic or semiplanktonic, rarely interstitial, species.
  9. Various taxonomical schemes of the order have been advanced over time (Zelinka 1889; Remane 1936; Schwank 1990; Kisielewski 1991). In particular the largest genus *Chaetonotus* (family Chaetonotidae) has been the subject of different subgeneric divisions (Remane 1936; Schwank 1990; Kisielewski 1997; Balsamo *et al.* 2009). Currently the state of taxonomy of the order Chaetonotida is quite unstable compared to the other order, Macrodasyida, for which a complete list of specific names and an overview of the world distribution have been provided by Hummon (2009).
  10. In the printing phase of the present work, one additional freshwater *Chaetonotus* species (Chaetonotida) has been published, which increases the total number of Gastrotricha known so far to 794.

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